# Accelerated Bridge Construction Case Study: Design Build Replacement of Rock Ridge Road Bridge


**Presenters:**

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# Rock Ridge Road Bridge

# Existing Bridge Site Conditions

- Rock Ridge Road is a rural road in Polk County
- Spans Gator Canal
- 2 span – 37 foot total length
- 29’-7” curb to curb width
- Poor horizontal bridge geometry
- Load Posted

# Existing Bridge Site Conditions

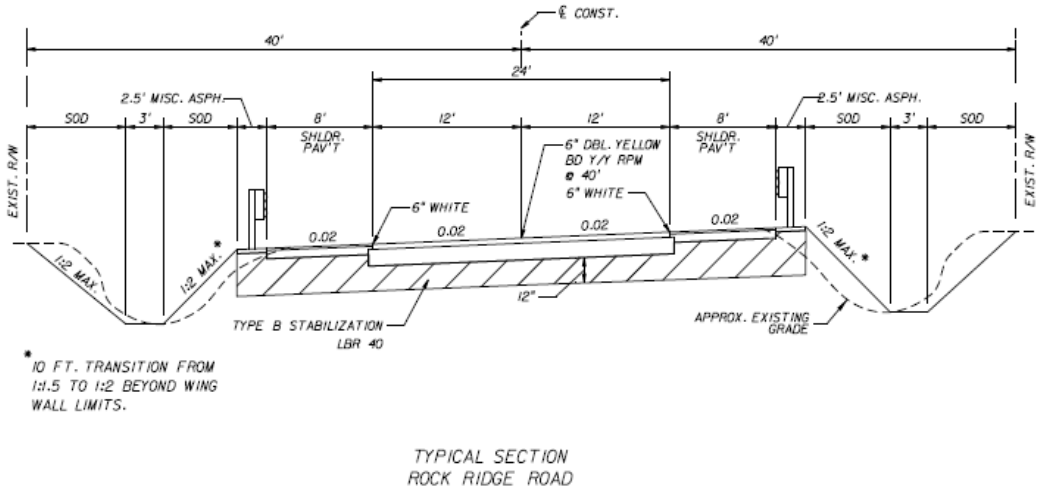
- Precast channel beams on concrete pile bents
- Roadway on curved alignment (7 degree – 747 foot radius curve)
- Non-standard roadway super-elevation

# Design Build RFP Requirements

- 12 foot lanes and 8 foot shoulders
- Maintain existing roadway alignment and profile
- Minimal roadway reconstruction
- On site detour per FDOT Index 606
- Schedule allowance: 470 calendar days

# Roadway Design - 1

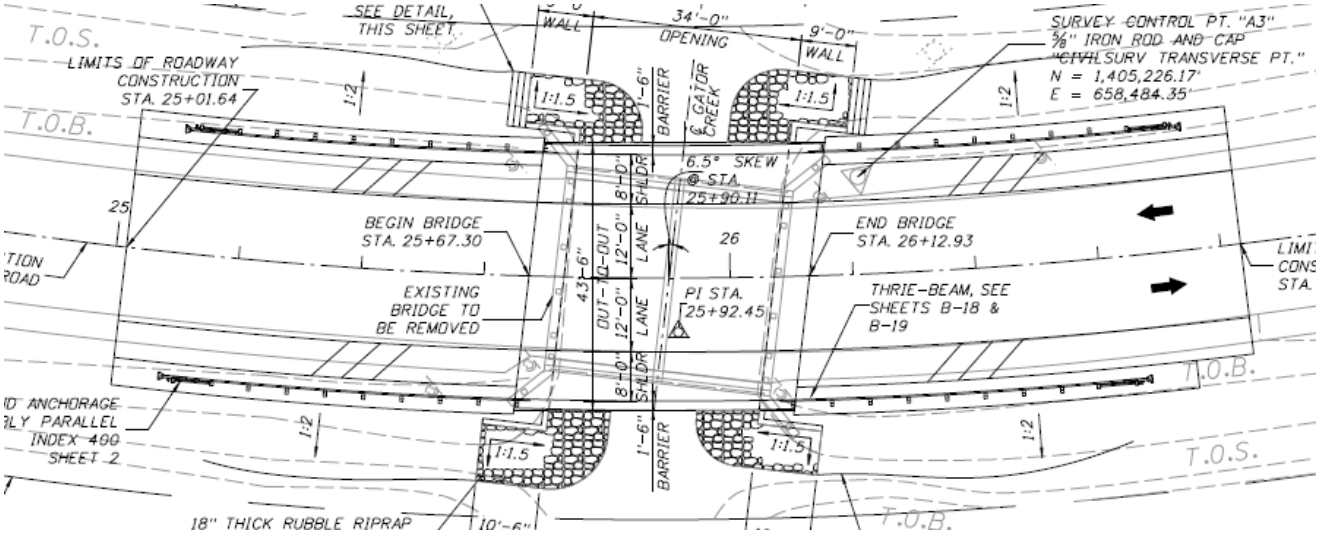
- Maintain existing horizontal & vertical centerline geometry
- Reverse crown typical section was specified




TYPICAL SECTION
ROCK RIDGE ROAD

- Design variance for super-elevation since the 10% super-elevation was not practical within the 50 foot reconstruction limits provided in RFP

# Roadway Design - 2




- Roadway reconstruction within limits of excavation and milling and resurface beyond those limits
- Thrie-beam and W-beam guard railing specified
- Post may be driven through GRS abutment layers
- Layout of wingwalls considered guardrail deflection

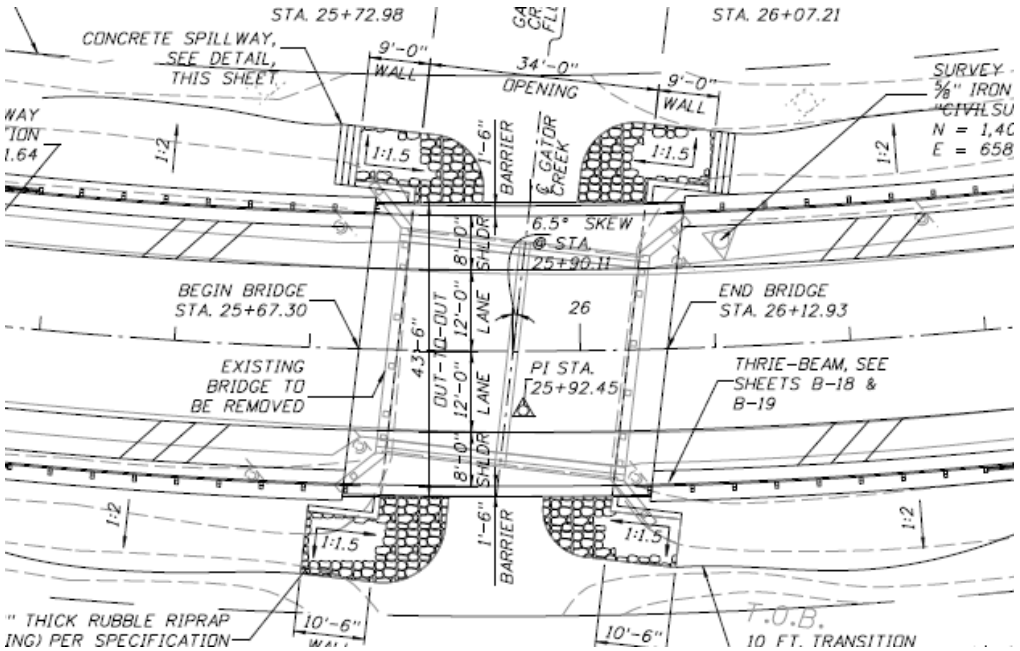
# Permitting

- SWFWMD Environmental Resource Noticed General Permit
- USACOE Nationwide Permit Number 13


- Proposed bridge encroached into wetlands and roadside ditches (surface waters)
- Design incorporated 1:1.5 slopes protected with rip rap instead of traditional 1:2 sodded slopes to minimize impacts
- This decision reduced cost & construction time due to a reduction in the length of the wingwalls

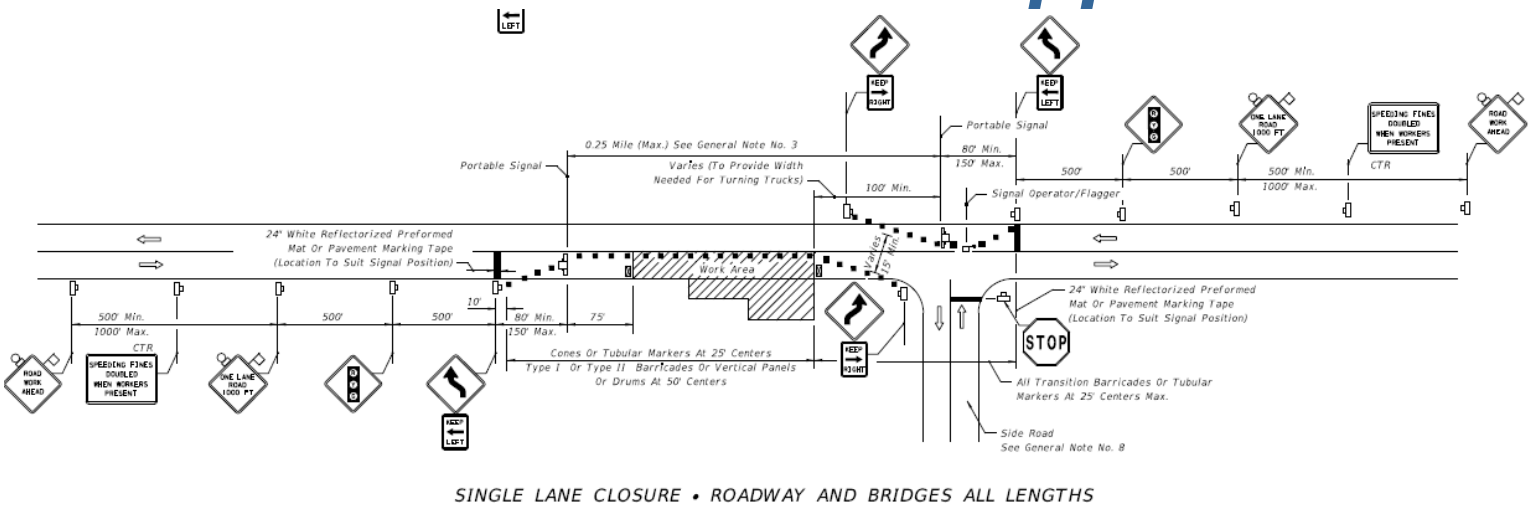
# Maintenance of Traffic (MOT) Challenges

- Bridge needed to be constructed in two phases
- AADT = 4217, Design Speed = 50 MPH, ROW = 80 feet
- Roadside ditches on both sides of road




- Creekwood Run approximately 200 feet from bridge
- Existing bridge at a skew to existing roadway
- Temporary critical wall (sheeting) interference

# Maintenance of Traffic Approach - 1

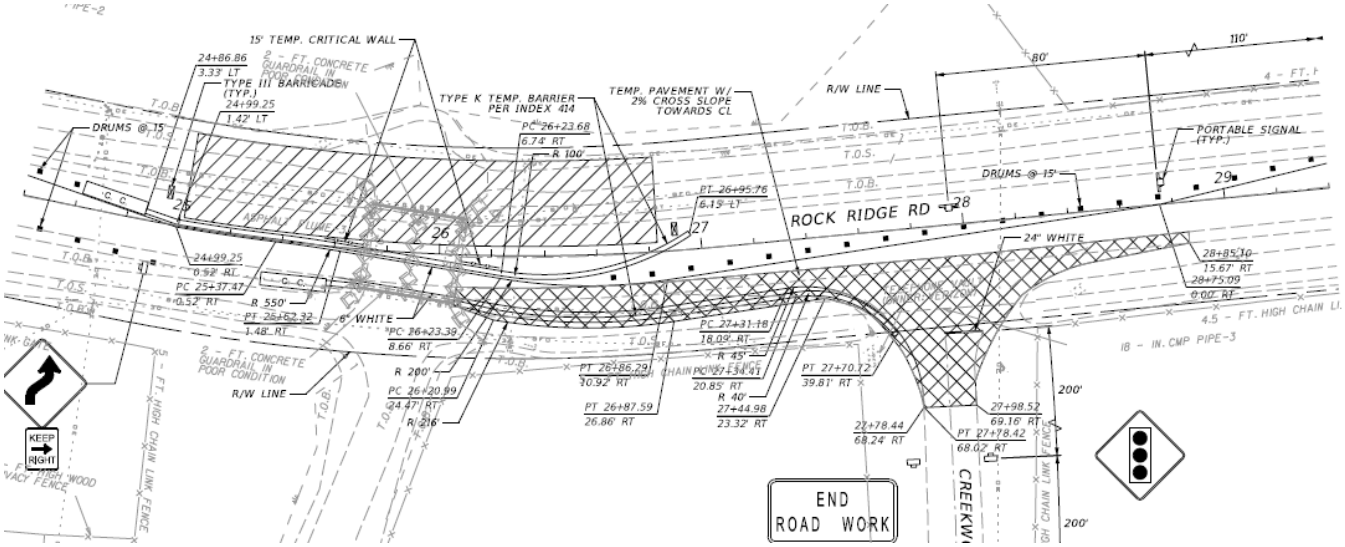



SINGLE LANE CLOSURE • ROADWAY AND BRIDGES ALL LENGTHS

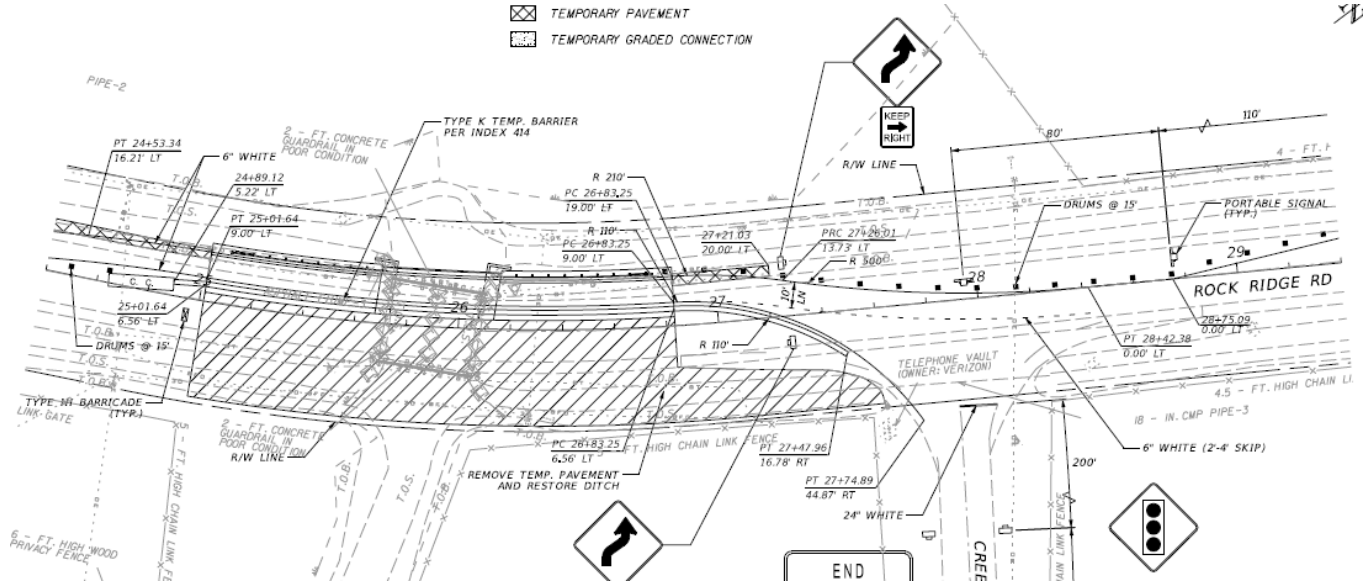
- Custom MOT design – similar to Index 606
- Detour speed of 25 MPH
- One lane, two way alternating traffic pattern
- Three phase temporary signal with 24/7 monitoring
- Type K barrier wall and supplemental lighting at night

# Maintenance of Traffic Approach - 2

- Phase I




- Phase II

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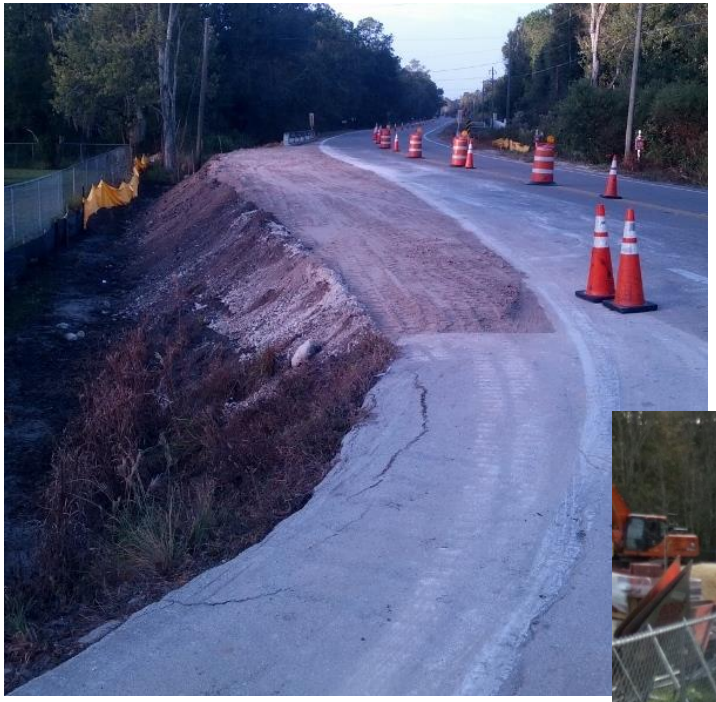
# Maintenance of Traffic Approach - 3



- Phase I – Looking West along Rock Ridge Road

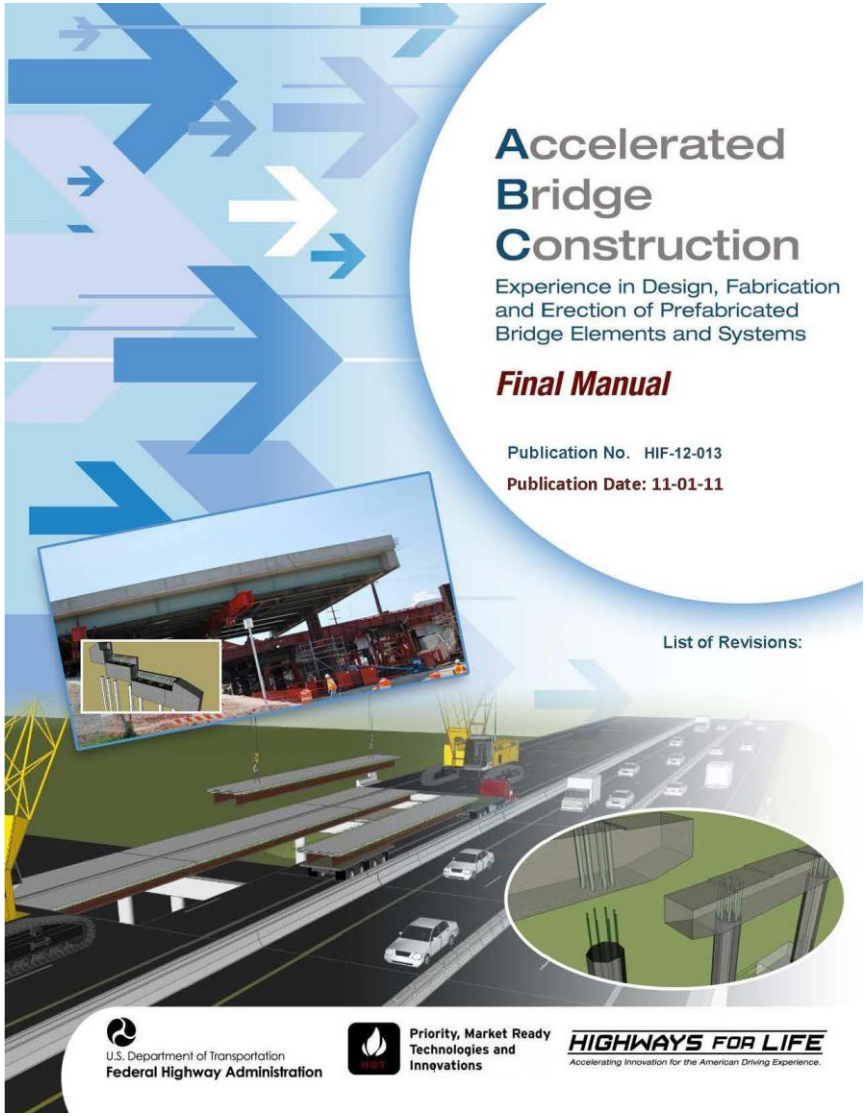
- Phase I – Looking West along Rock Ridge Road

# Maintenance of Traffic Approach - 4

- Phase II – Looking West along Rock Ridge Road
- Portable signal in the background
- Existing bridge beams not parallel to skew of the existing roadway

# Why Accelerated Bridge Construction (ABC)?

- Reduce construction duration
- Minimize traffic impacts
- Construction zone safety benefits
- Less disruptive to environment
- Utilizes quality materials
- Manufactured in plant controlled conditions



# *ABC Approach for Substructure Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS)*

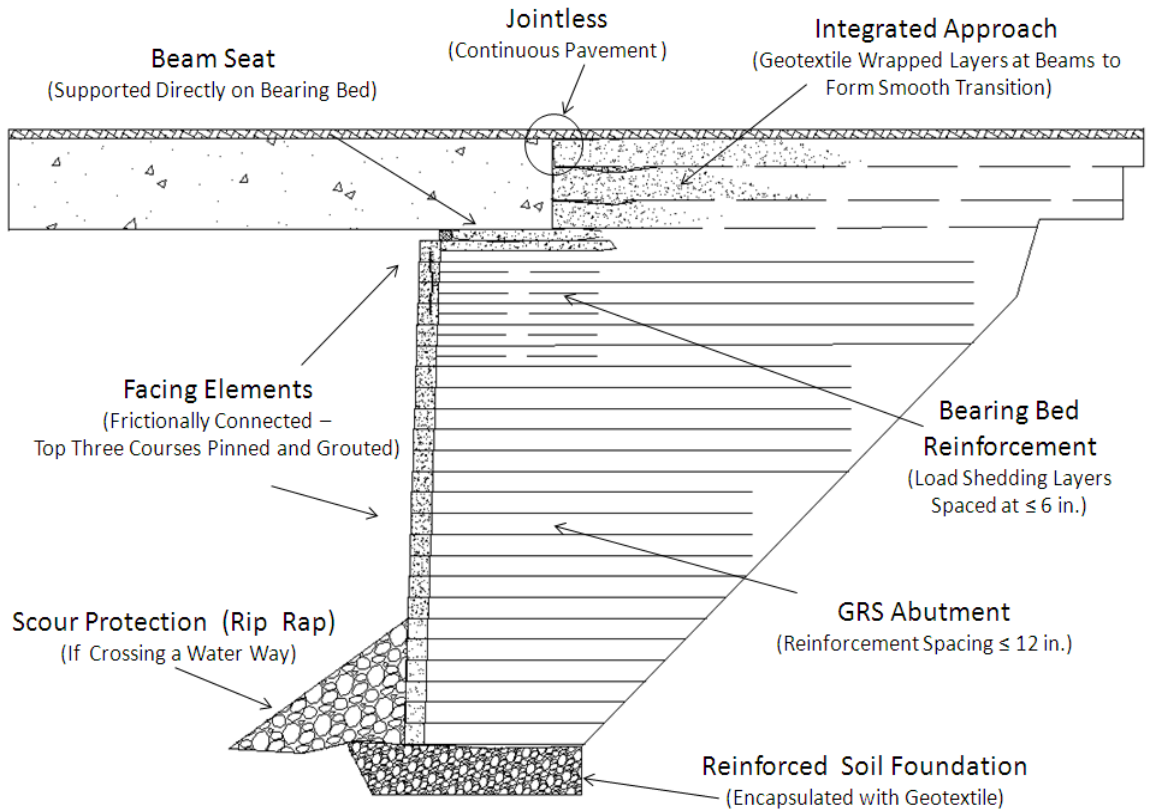
- Alternating layers of compacted gravel and layers of geosynthetic reinforcement
- Eliminates approach slabs, piles, expansion joints, bearings, and CIP concrete
- Alleviates the “bump at the bridge” problem
- Reduced construction time

# ABC Approach for Substructure GRS-IBS

- Less dependent on weather conditions
- Flexible design – easily modified for unforeseen site conditions
- Built with common equipment and materials

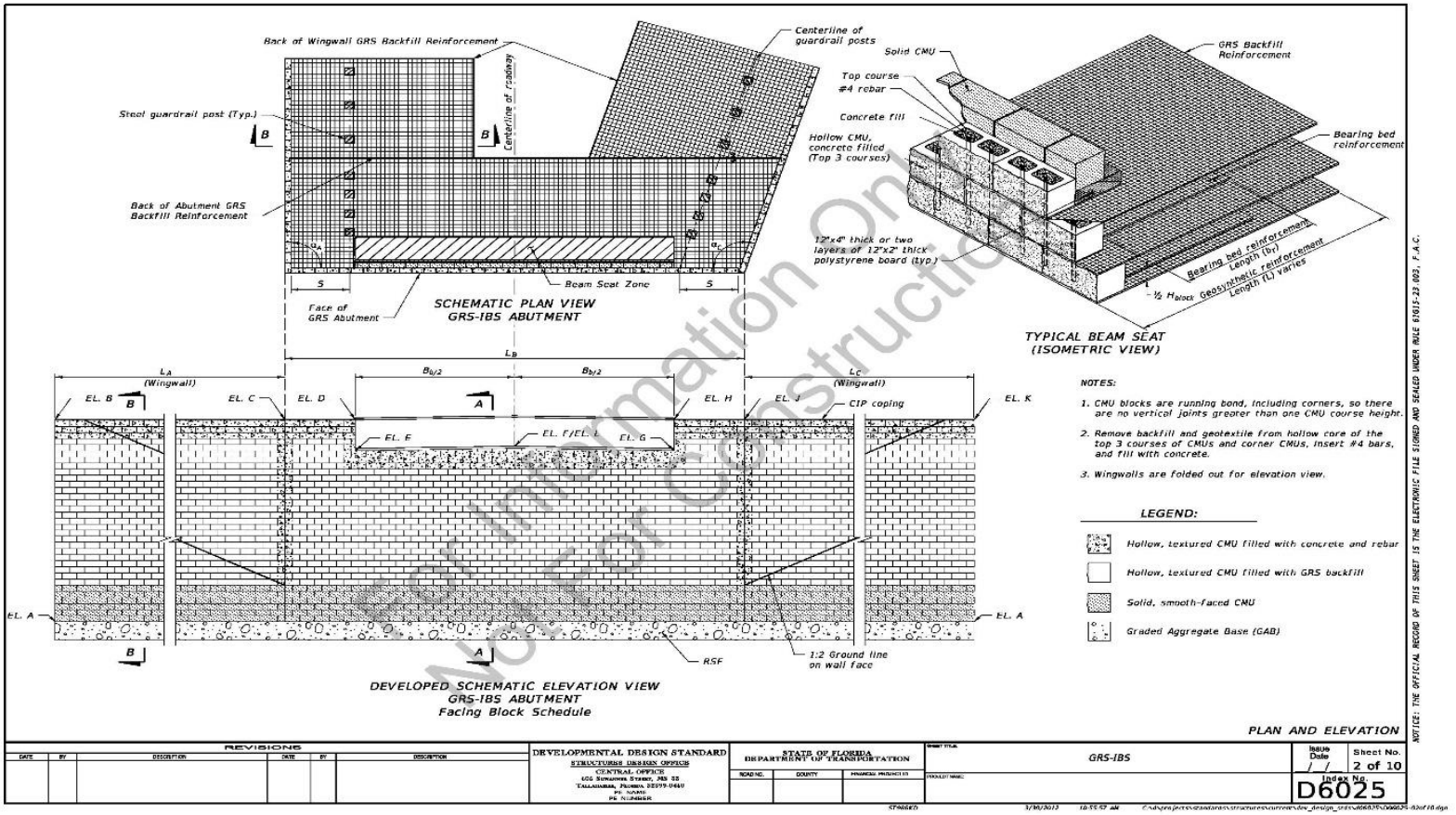
# ABC Approach for Substructure GRS-IBS

- Designed per Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide (Pub. No. FHWA-HRT-11-026)



# ABC Approach for Substructure GRS-IBS

- Utilized details provided in FDOT's Developmental Design Standard Index D6025

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# GRS-IBS Facing Elements

- D6025 requires the use of conventional concrete masonry units (CMUs)
- “Vertica” block used for this project
- Advantages included built in 2% batter, reduced dimensional tolerances, enhanced aesthetics, and is manufactured using 4,000 psi concrete, less prone to impact damage at front face

# ABC Approach -Prefabricated Superstructure

- Precast, prestressed concrete adjacent slab units – 18” x 3’-8” x 45’-7”
- Eliminated FDOT standard 6” CIP composite concrete deck


# ABC Approach -Prefabricated Superstructure

- Transverse post tensioning - high strength steel rods
- In accordance with AASHTO 5.14.4.3 and SDG. 4.4.

# ABC Approach -Prefabricated Superstructure

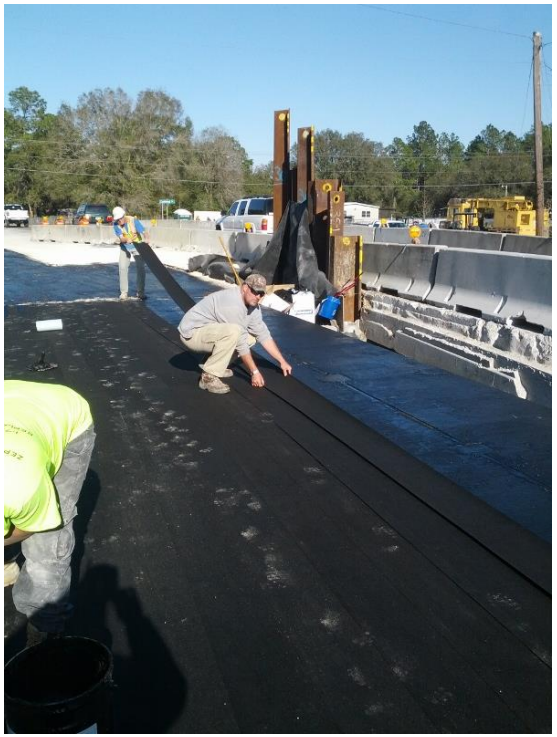
- 250 psi pre-compression on grouted shear key joints
- 1.25” Dia. Dywidag Bars - 7’ spacing - Tensioned to 131kips

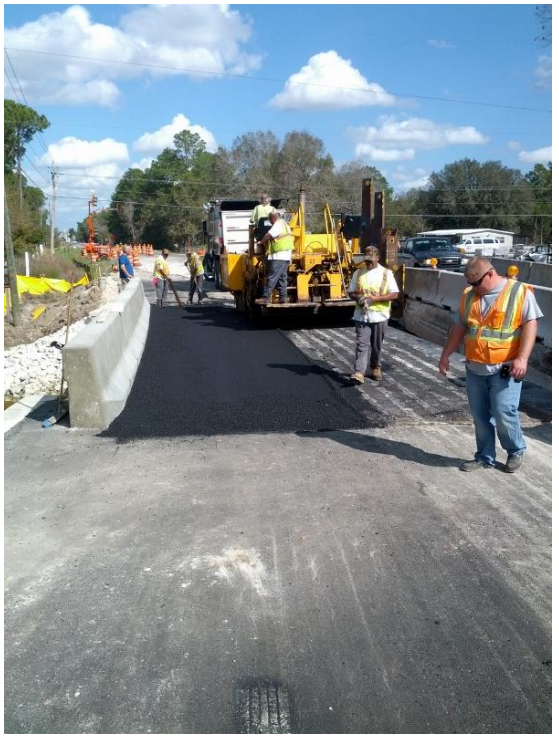
# ABC Approach -Prefabricated Superstructure

- No post tensioning systems on QPL
- Required custom design

# ABC Approach -Prefabricated Superstructure

- 2” thick asphalt overlay over a membrane waterproofing system
- Technical Special Provision (TSP) required for membrane waterproofing



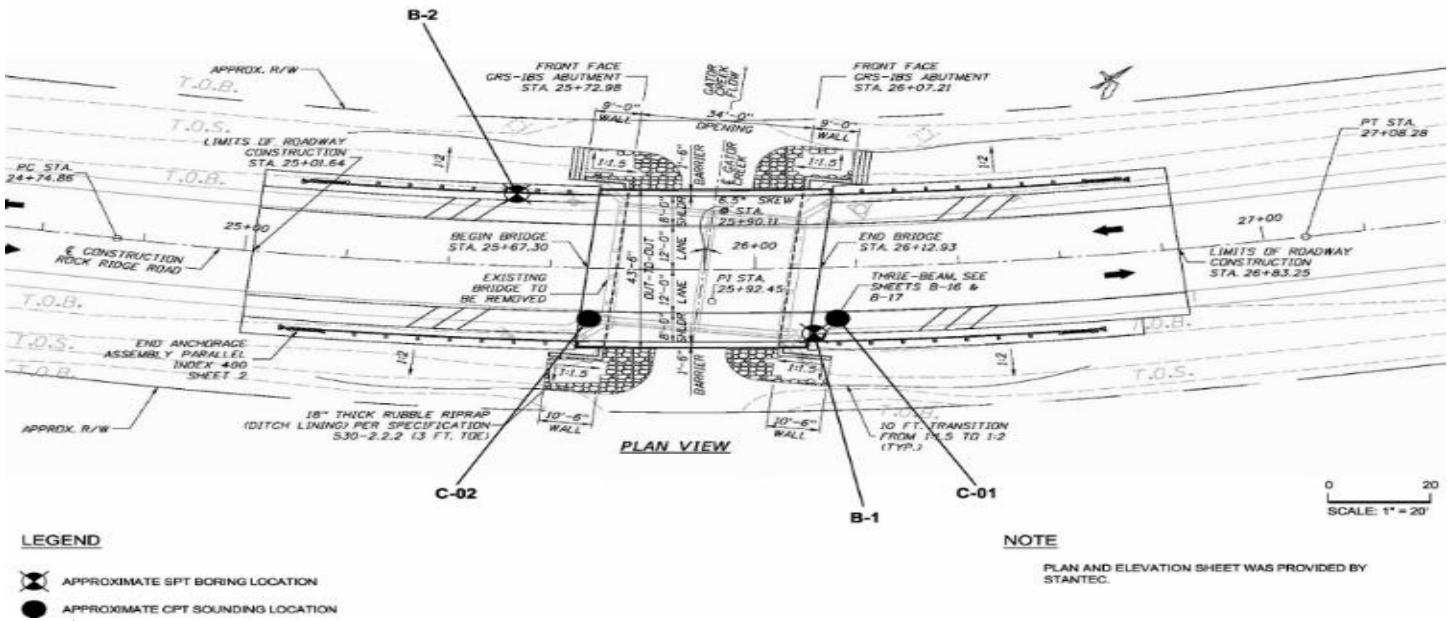


# ABC Approach -Prefabricated Superstructure

- Minimized CIP concrete bridge components
- F-shaped barriers and slab unit 2’- 9”closure pour

# Foundations

- (1) Standard Penetration Test (SPT) boring provided during Request for Proposal (RFP)
- Not in close proximity for GRS-IBS design
- Stipend money used to procure (2) additional SPT borings

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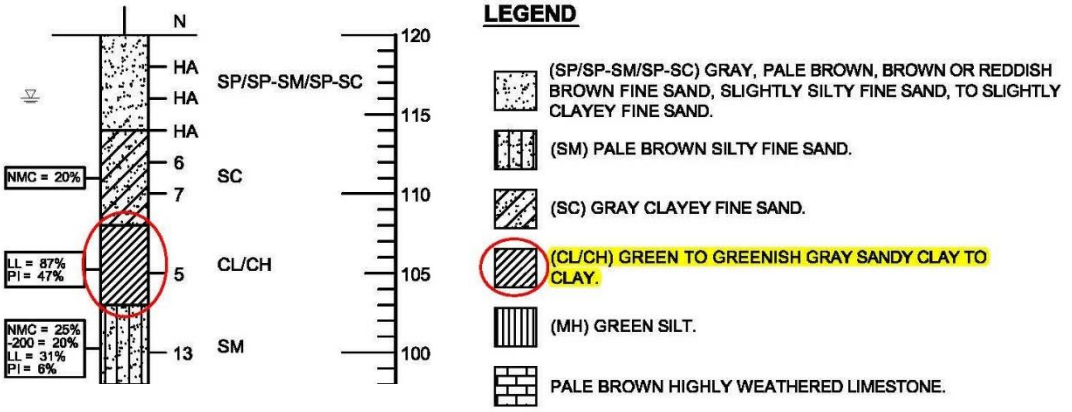
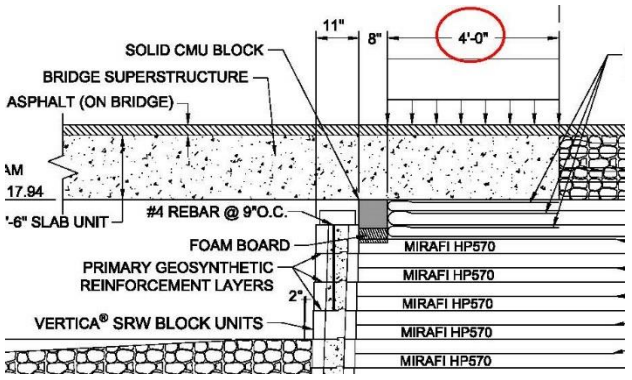
# Foundations

- Pockets of green clay layer encountered
- Settlement a concern
- Mitigate settlement by increasing slab unit bearing width “b” from 30” min. required to 48”
- Unfactored bearing pressure at GRS base = 1,883 PSF

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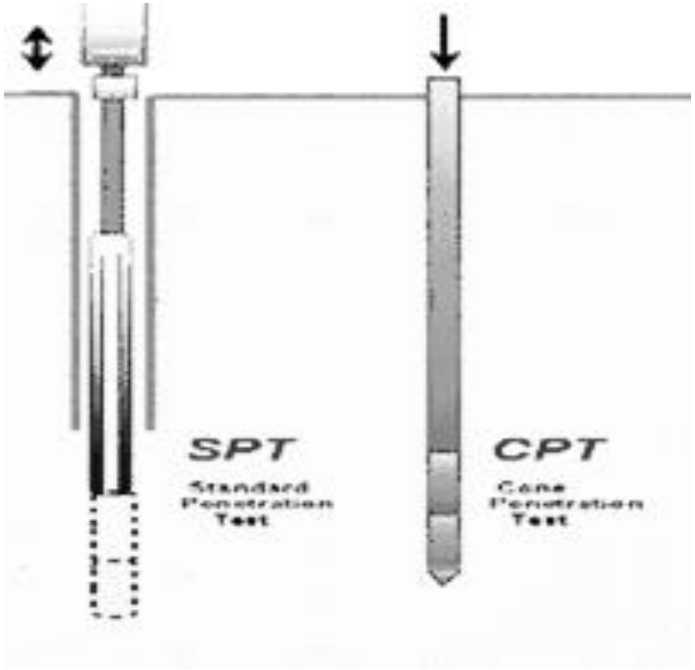
# Foundations

- Cohesive soils: SPT vs. CPT?
- Procured (2) Cone Penetrometer Tests prior to final design
- CPT test more reliable/accurate than SPT



# Foundations

- Final settlement calculations allayed concerns
- Final asphalt layer placement to mitigate differential settlement

# Hydraulics

- Gator Canal is an intermittently flowing riverine
- Wetlands on both sides of bridge

# Hydraulics

- Total scour potential = 2 feet
- Design velocity = 2.1 feet/sec

## HYDRAULIC DESIGN DATA

**NOTE:**

*The hydraulic data is shown for informational purposes only to indicate the flood discharges and water surface elevations which may be anticipated in any given year. This data was generated using highly variable factors determined by a study of the watershed. Many judgements and assumptions are required to establish these factors. The resultant hydraulic data is sensitive to changes, particularly antecedent conditions, urbanization, channelization and land use. Users of this data are cautioned against the assumption of precision which cannot be obtained.*

**TERMS:**

*Design Flood: Utilized to assure a desired level of hydraulic performance.*
*Base Flood: Has a 1% chance of being exceeded in any given year (100 year frequency)*
*Overtopping Flood: Causes flow over the highway, over a watershed divide, or thru emergency relief structures.*
*Greatest Flood: The most severe that can be predicted where overtopping is not practicable.*

WATER SURFACE ELEVATIONS: N.H.W. (Non-Tidal) 115.00 M.H.W. (Tidal) N/A
CONTROL (Non-Tidal) N/A M.L.W. (Tidal) N/A

| FLOOD DATA: | MAX. EVENT OF RECORD | DESIGN FLOOD | BASE FLOOD | ☐ OVERTOPPING or ☒ GREATEST FLOOD |
|---|---|---|---|---|
| STAGE ELEV. NAVD (ft) | N/A | 116.0 | 116.31 | 116.62 |
| DISCHARGE (cfs) | N/A | 56.6 | 83.7 | 117.10 |
| AVERAGE VELOCITY (f/s) | N/A | 2.11 | 2.59 | 3.23 |
| EXCEEDANCE PROB. (%) | N/A | 10 | 1 | 0.2 |
| FREQUENCY ( yr.) | N/A | 10 | 100 | 500 |

**SCOUR PREDICTIONS FOR PROPOSED STRUCTURE DESCRIBED ABOVE:**

| PIER INFORMATION | | | TOTAL SCOUR ELEVATION | |
|---|---|---|---|---|
| NUMBERS | SIZE AND TYPE | LONG TERM SCOUR ELEV. | WORST CASE ≤ 100 yr. FREQ. (yr.) 100 | WORST CASE ≤ 500 yr. FREQ. (yr.) 500 |
| 1 | N/A | N/A | 114.04 | 112.08 |
| 2 | N/A | N/A | 113.90 | 113.45 |

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# Hydraulics

- Scour countermeasures
- Risk vs. Cost
- Rubble rip rap (ditch lining)

# Construction

- Bridge Demolition
- Temporary steel sheet piling for roadway support
- Construction of the GRS – IBS system in 2 phases

# Construction

- GRS-IBS wall system construction process
- Preparing for structural concrete beams
- Setting and post-tensioning concrete beams

# Construction

- Roadway Construction – Graded Aggregate Base
- Concrete Deck Waterproofing

# Construction

- Constructing Phase 2 of the GRS-IBS system using temporary wall system
- Constructing GRS Wall vertically straight vs. staggered block

# Construction

- The Process of Construction is repeated
- Final Roadway Construction

# Construction

- Construction Issues to be aware of:
  - ✓ Post-Tensioning Grouting – protecting sleeves during grouting process
  - ✓ GAB Material availability
  - ✓ Elevations at each stage of construction

# Construction

- Construction Benefits
  - ✓ Time
  - ✓ Material Usage – Procurement
  - ✓ Maintenance

# *Thank you to FDOT for the opportunity to present.*